Status of FNAL SciBooNE experiment

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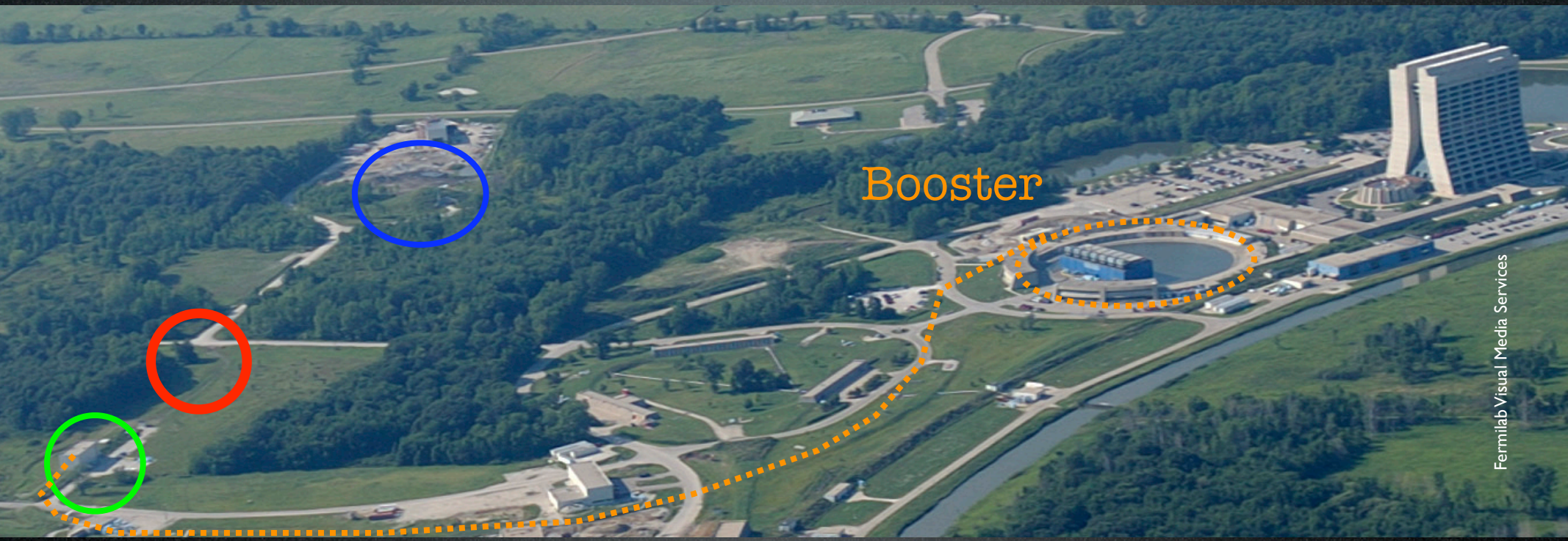
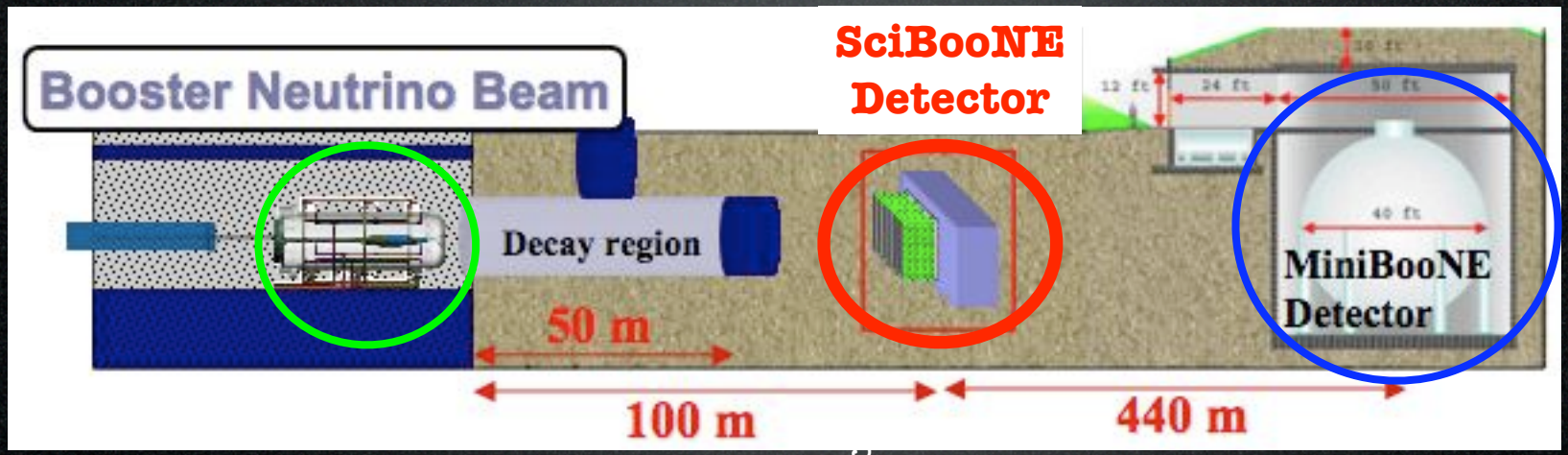
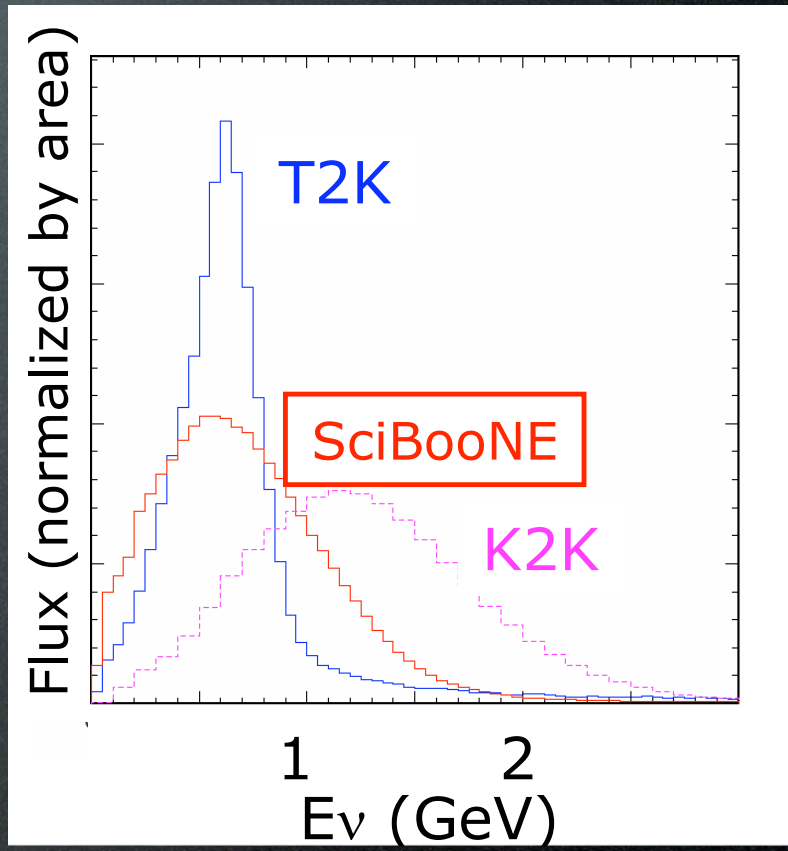
Overview


Booster
Fermilab Visual Media Services


Booster Neutrino Beam
SciBooNE
Detector
Decay region
50 m
100 m
440 m
MiniBooNE
Detector

Physics Motivation

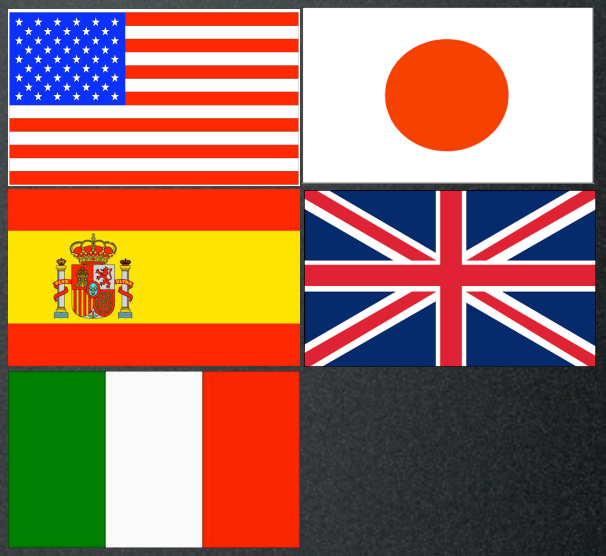
- Precision study of neutrino cross-sections below 1 GeV region.
  - Directly helps T2K
- MiniBooNE near detector.



1×10^{20} POT for neutrinos
1×10^{20} POT for anti-neutrinos

SciBooNE collaboration

- Universitat Autonoma de Barcelona
- University of Cincinnati
- University of Colorado
- Columbia University
- Fermi National Accelerator Laboratory
- High Energy Accelerator Research Organization (KEK)
- Imperial College London*
- Indiana University
- Institute for Cosmic Ray Research
- Kyoto University*
- Los Alamos National Laboratory
- Louisiana State University
- Purdue University Calumet
- Università degli Studi di Roma and INFN-Roma
- Saint Mary's University of Minnesota
- Tokyo Institute of Technology
- Universidad de Valencia



Spokespeople:
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M.O. Wascko, Imperial College

SciBooNE Timeline

Two years from formation to first data!

- 2005, Summer - Collaboration formed
- 2005, Dec - Proposal
- 2006, Jul - Detectors move to FNAL
- 2006, Sep - Groundbreaking
- 2006, Nov - EC Assembly
- 2007, Feb - SciBar Assembly
- 2007, Mar - MRD Assembly
- 2007, Mar - Cosmic Ray Data
- 2007, Apr - Detector Installation
- 2007, May - Commissioning
- 2007, Jun - Anti-Neutrino Data Run

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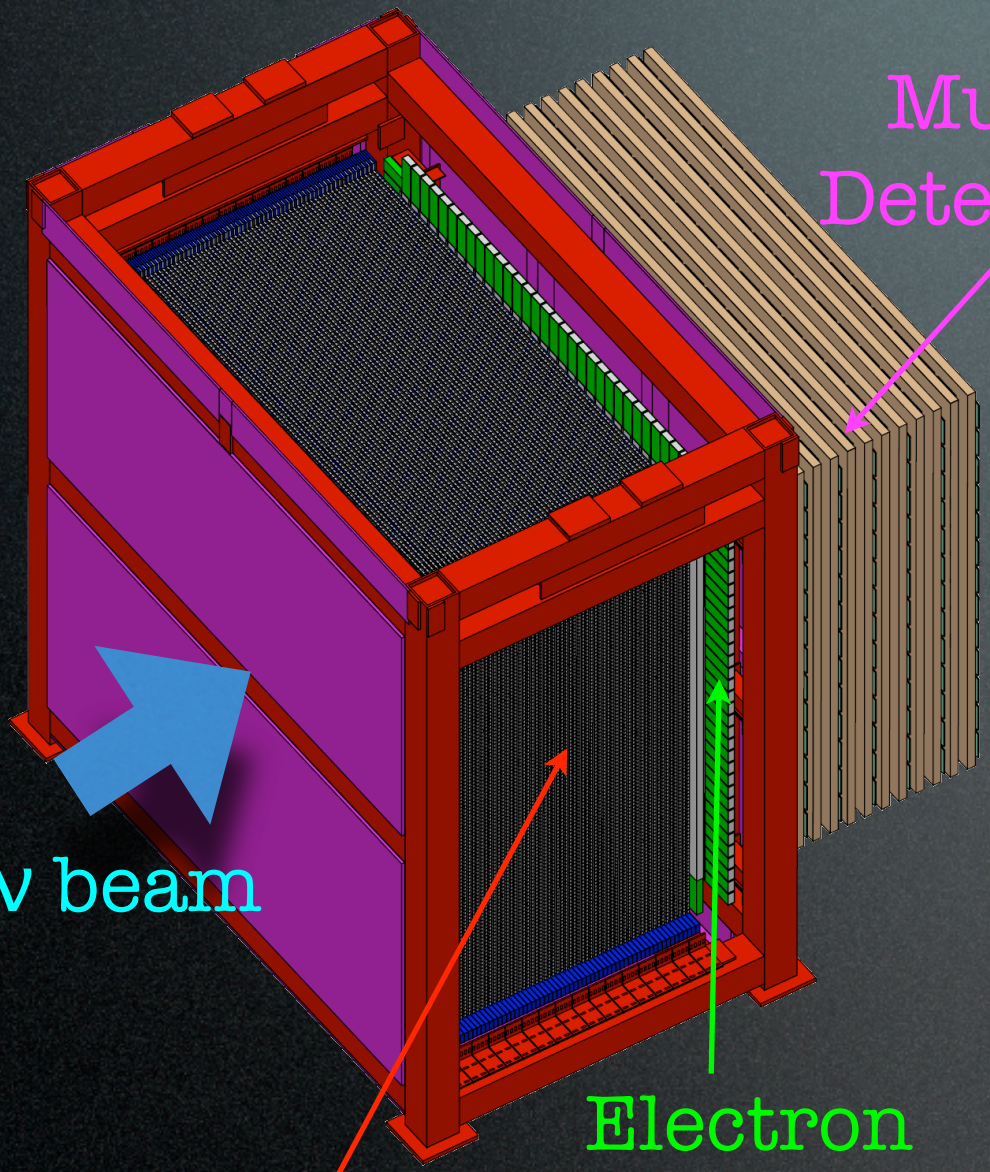
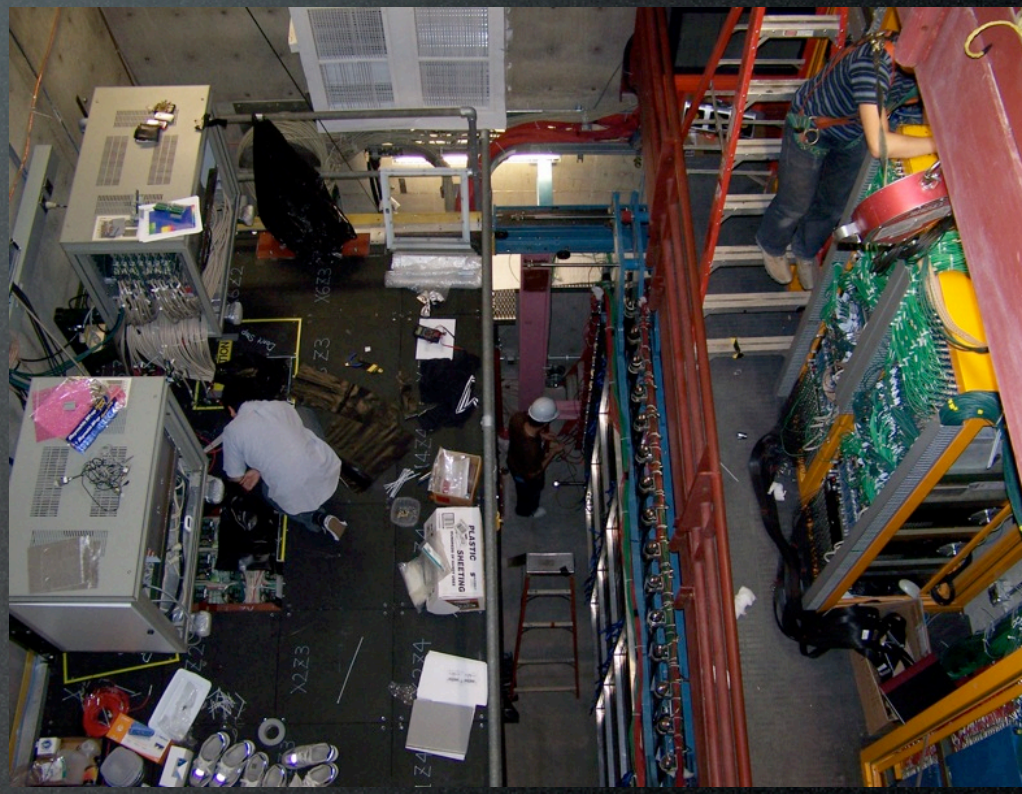
We worked hard to ensure the success of the installation!

SciBooNE Detectors



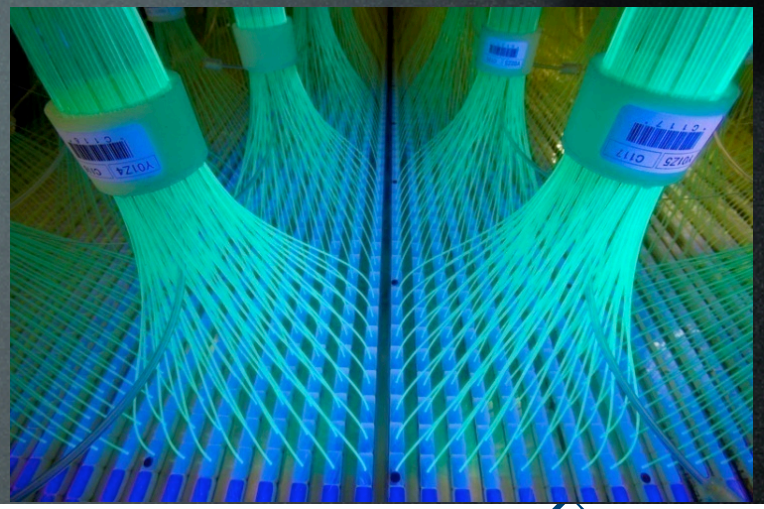
SciBooNE detectors during cabling

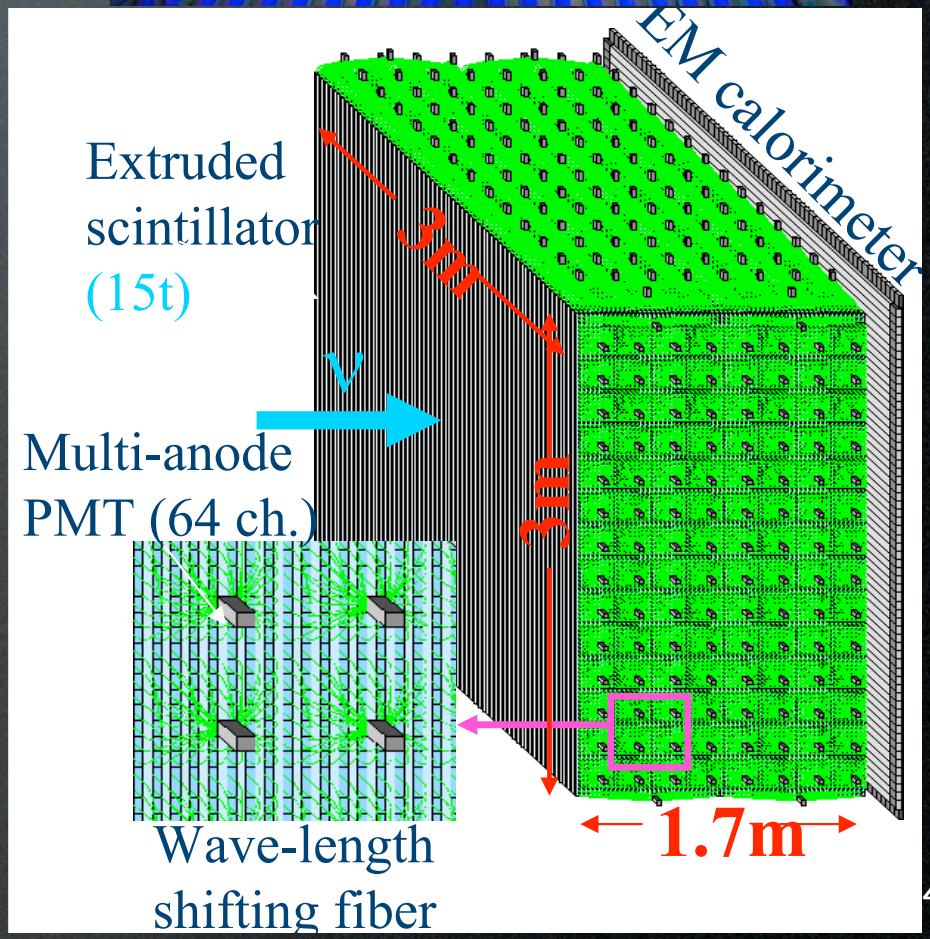


SciBar/EC MRD

SciBar detector

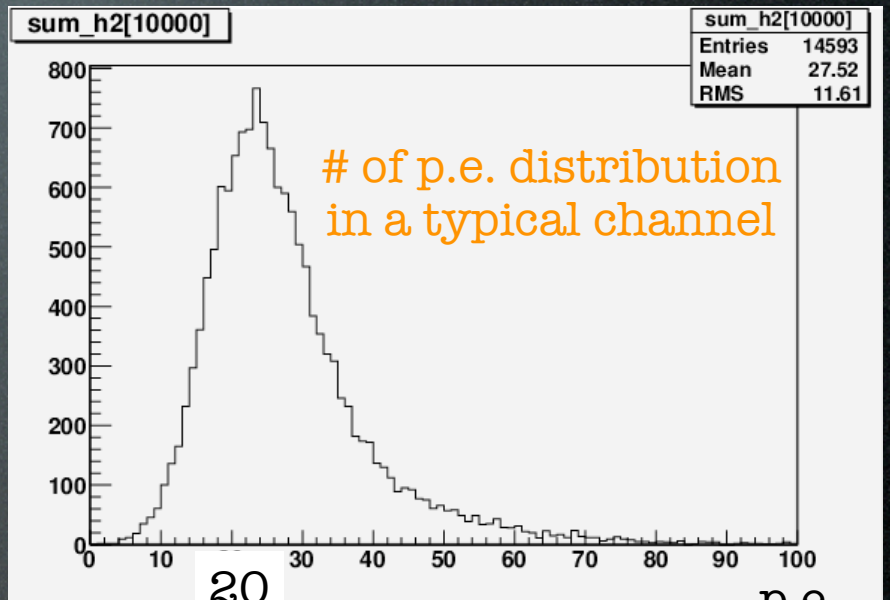
- Fully active fine-segmented tracker.
- Neutrino target.
- Extruded scintillator with WLS fiber readout.
  - 2.5 x 1.3 x 300 cm^3 cell.
  - 14,336 channels.
- Total 15 tons.
- Detect short tracks (>8cm)
- p/π separation by dE/dx.
- Originally used in K2K experiment.

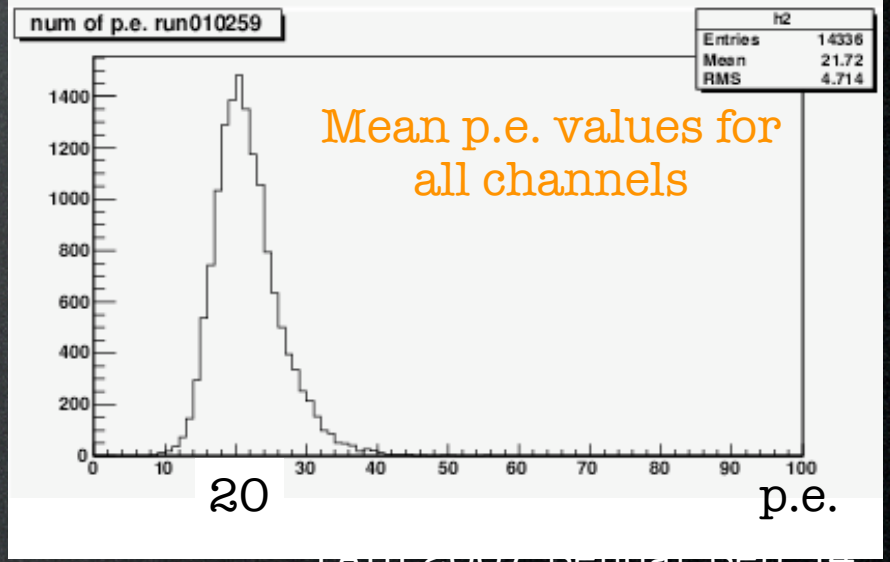




Basic Performance of SciBar Detector

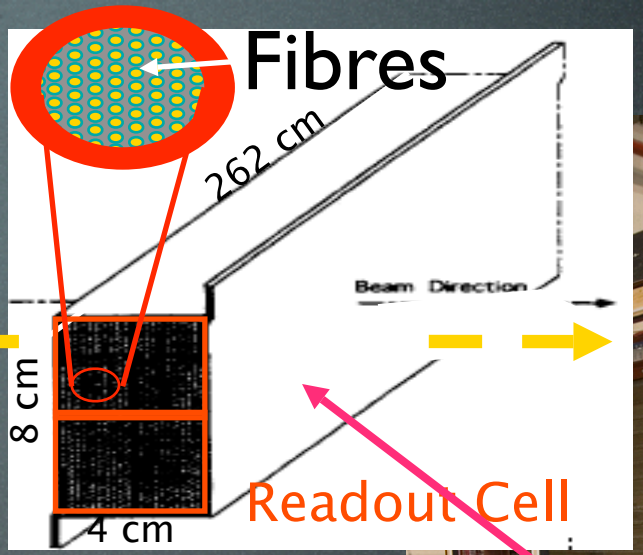
- Light yield for minimum ionizing particle:
  - ~20 p.e./1.3 cm @ 30cm from PMT (average of all channels)
- Hit finding efficiency:
  - Horizontal plane: 99.9%
  - Vertical plane: 99.8%
- # of dead channel:
  - only 4/14336 channels (0.03%)

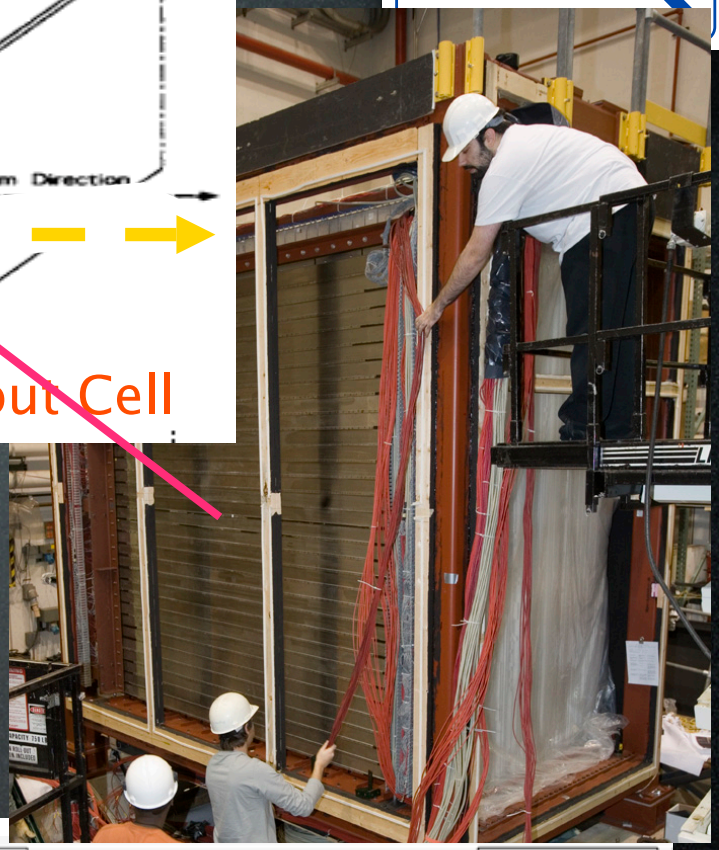


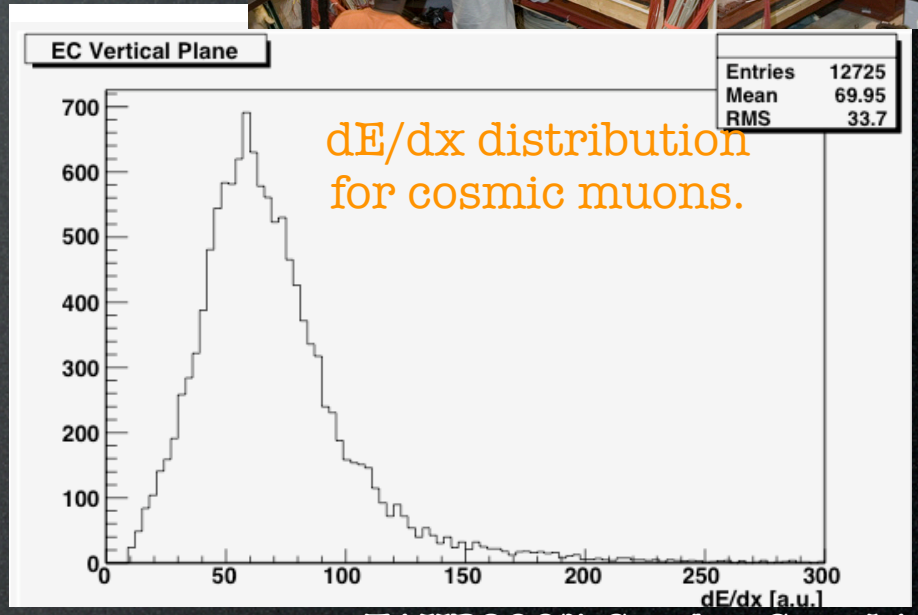


Electron Catcher (EC)

- "spaghetti" calorimeter re-used from CHORUS and K2K.
- 1 mm diameter scintillating fibers in the grooves of lead foils.
- 4x4cm^2 cell readout from both ends.
- 2 planes (11X_0)
  - Horizontal: 32 modules
  - Vertical: 32 modules
- Total 256 readout channels.
- Expected resolution 14%/$\sqrt{E}$.
- Linearity: better than 10%.

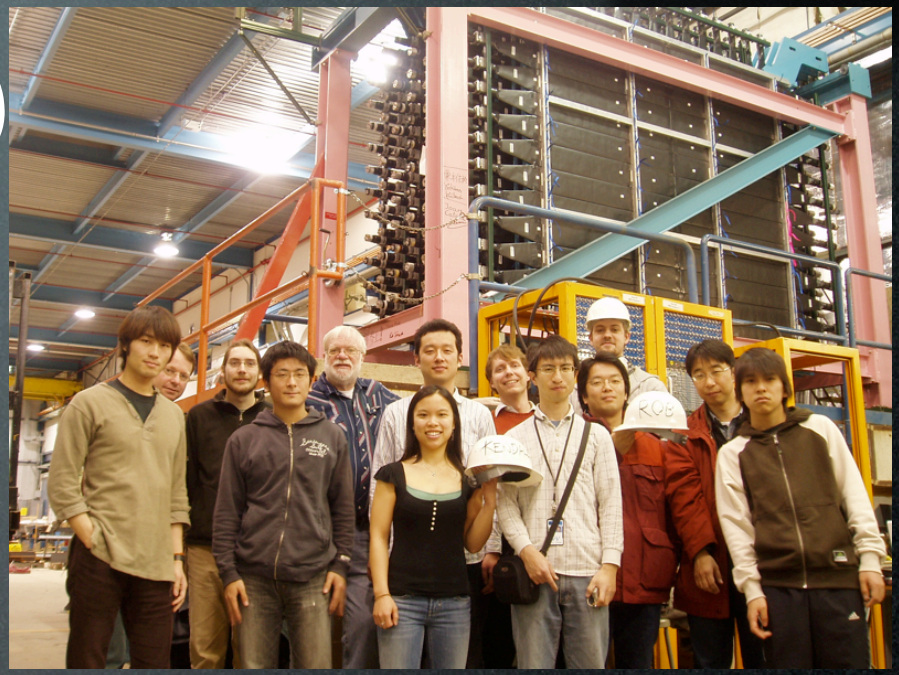




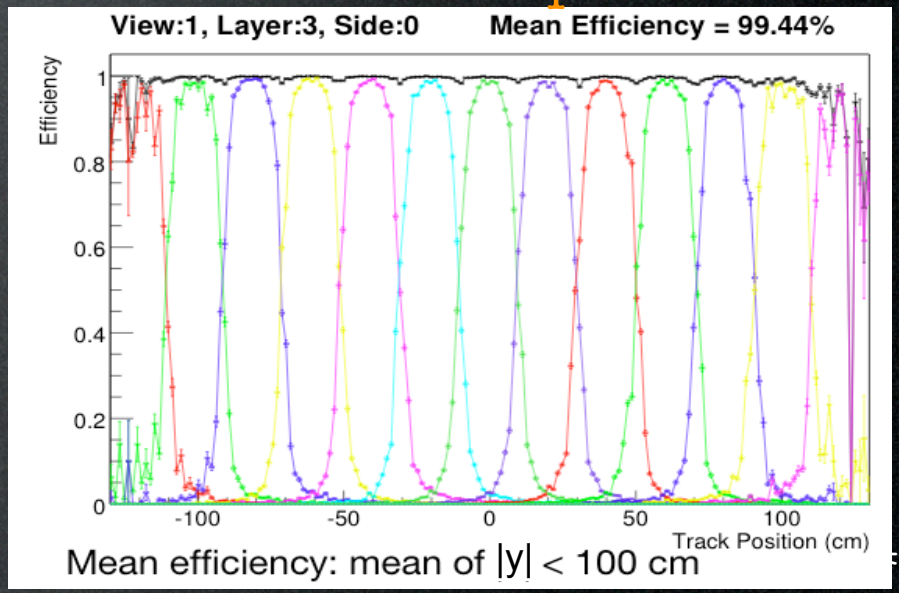


Muon Range Detector (MRD)

- A new detector build with used scintillators, iron plates and PMTs to measure muon momentum up to 1.2 GeV
- Iron plate:
  - 305x274x5cm^3.
  - Total 12 layers.
  - Total ~40 tons.
- Scintillator Plane
  - Alternating horizontal and vertical planes.
  - Total 362 channels.

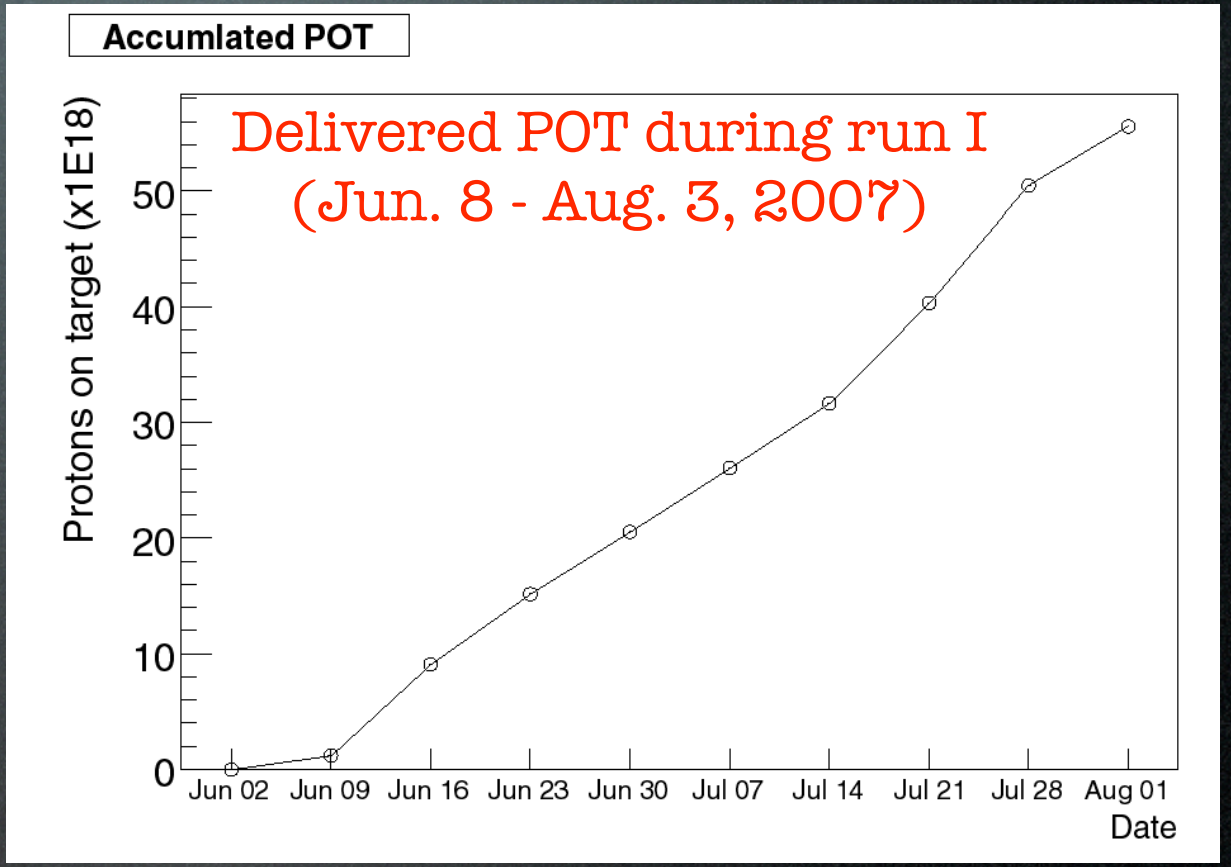


Hit efficiency for typical horizontal plane



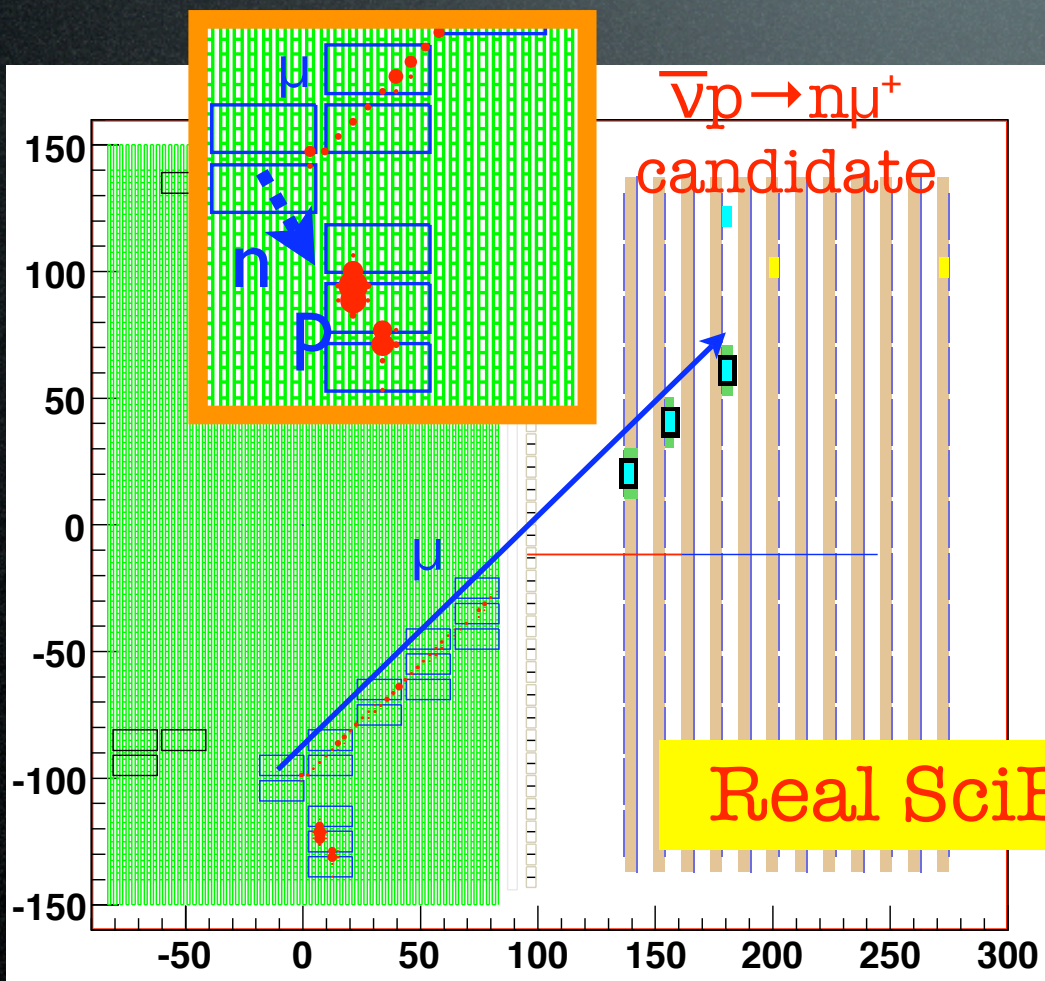
First data run

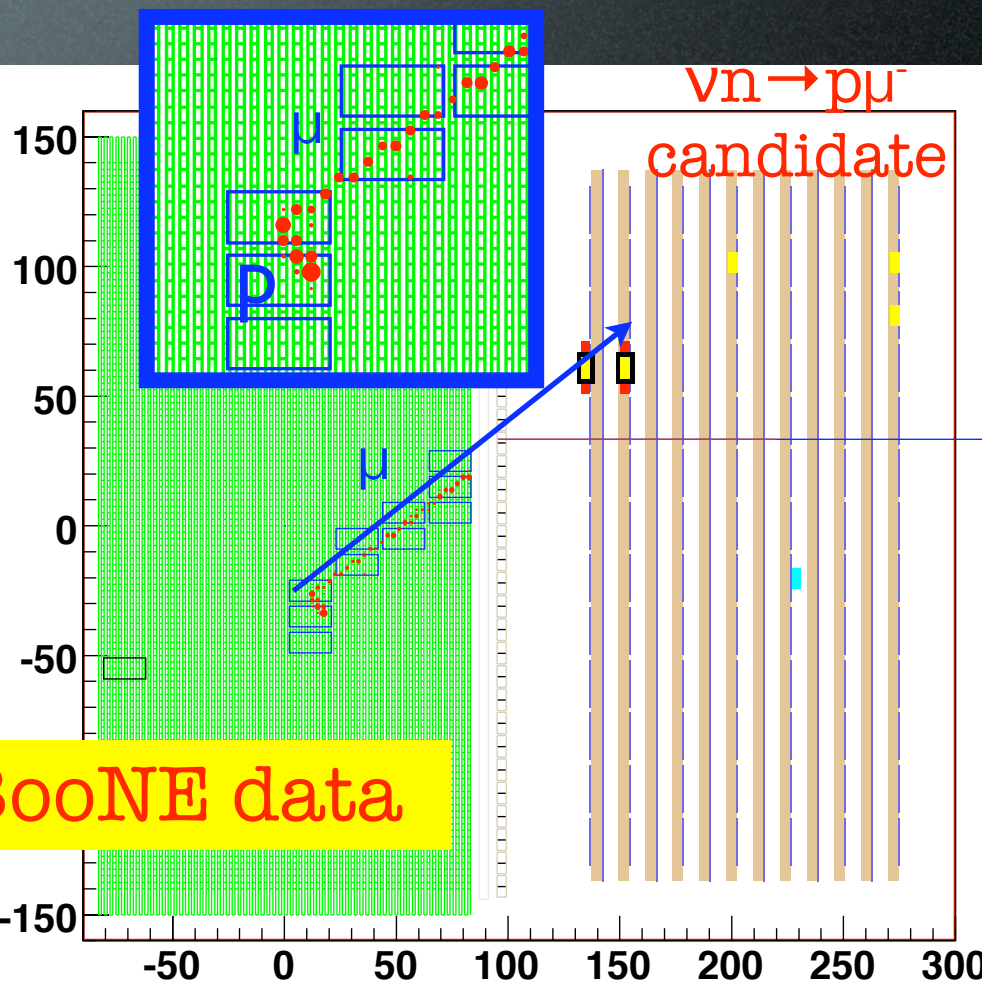
- Run I: Jun. 8 - Aug. 3, 2007.
- Anti-neutrino mode.
- Delivered 5.45×10^{19} POT.
- Detector live time fraction: ~95%.



Half of projected for anti-neutrino mode!

$\bar{\nu}$ and ν CCQE events





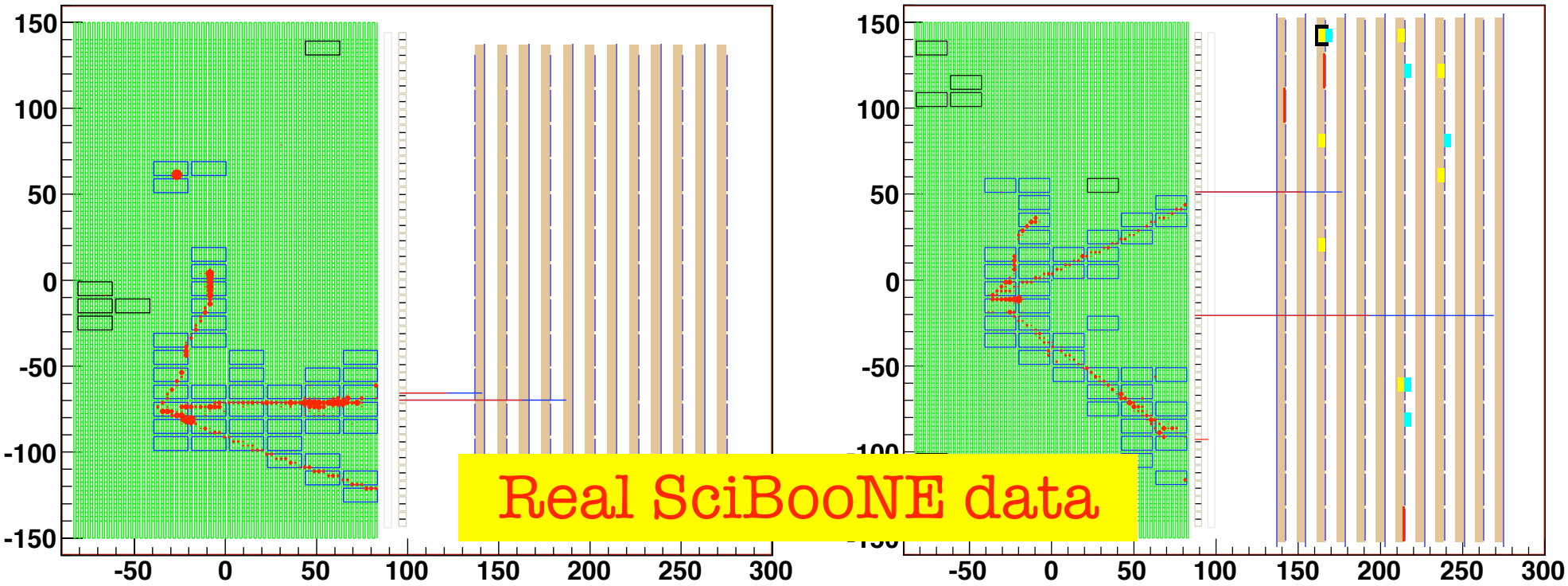
Real SciBooNE data

Anti-neutrino and neutrino interactions are clearly distinguished

Multi-track event

Side view

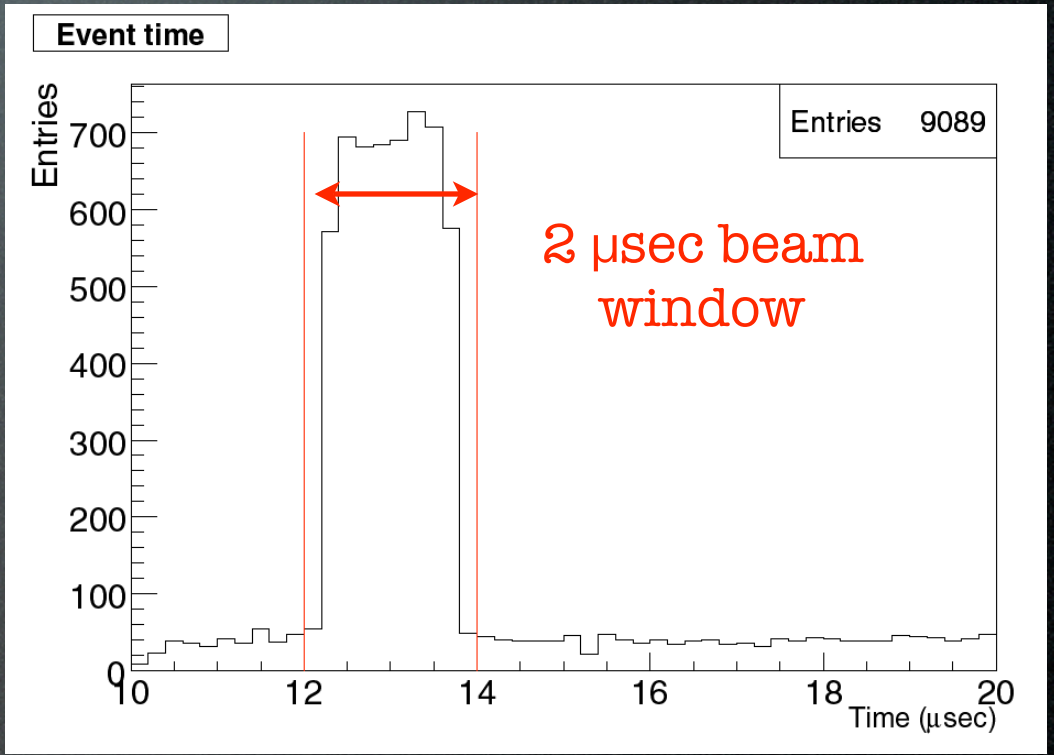
Top view



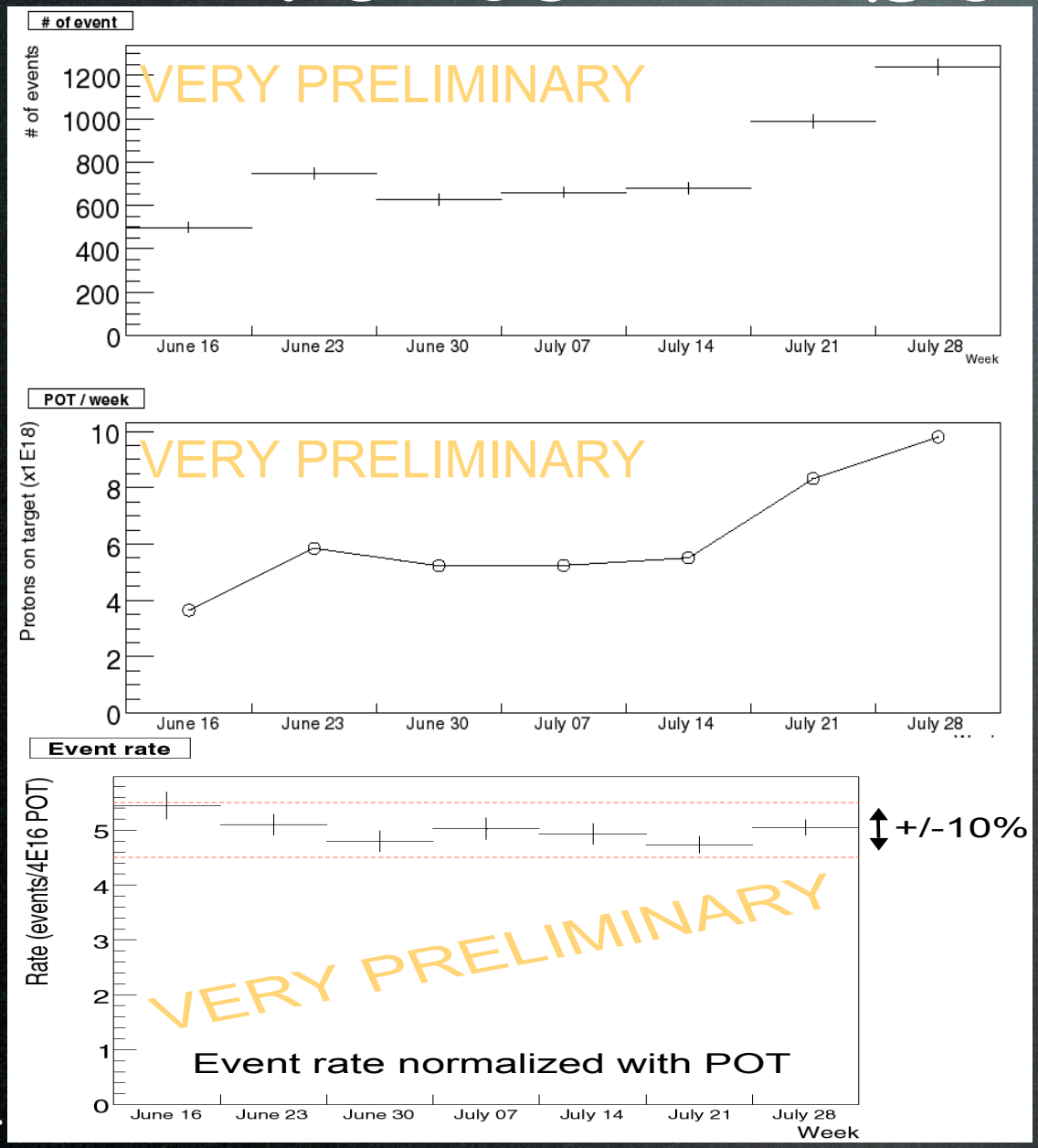
CC Candidate vertex inside SciBar

- Simple selection:
  - Require a hit in the most downstream layer.
  - Track penetrating more than 4 layers.
  - Vertex inside the FV of SciBar. (FV mass: 10.6 tons)
  - Within 2 μsec beam window.
- Note: This selection is just stability checks (not for physics)

Event timing of CC candidate vertex inside SciBar



CC Candidate events vertex in SciBar



- CC event candidates vertex inside SciBar: ~5000 events.
  - FV mass: ~10.6 tons.
  - Period: July 12 - July 28. (~4x10^{19} POT)
- Event rate normalized with POT stable within ±10%.

Note:
CC event efficiency: ~45%

CC event purity: ~94%

$\overline{\nu}$/ν fraction: $\overline{\nu}$ ~63%, ν ~36%

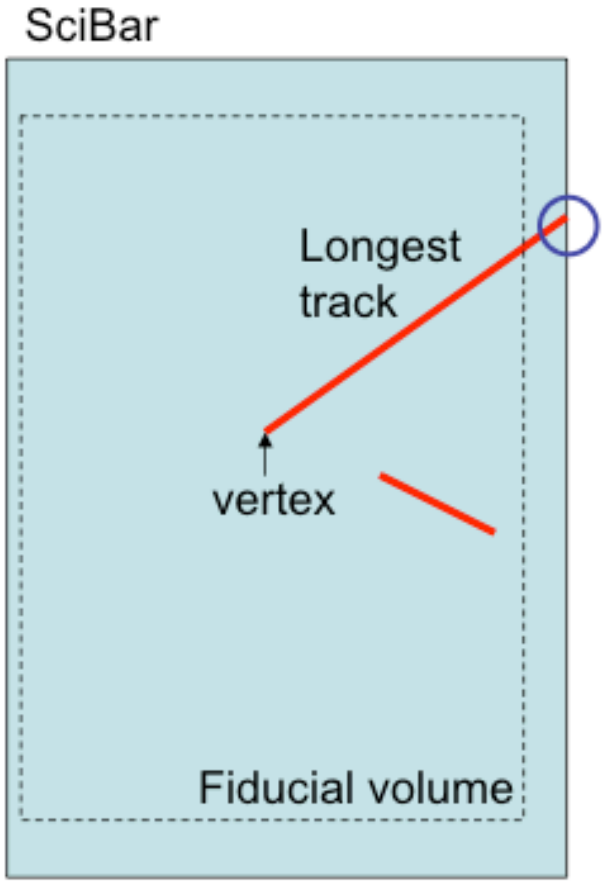
(estimated by MC)

Summary

- SciBooNE: Precise study of neutrino and anti-neutrino interactions near 1 GeV.
- Project 2×10^{20} P.O.T.
- SciBooNE detectors are working well.
- SciBooNE has collected anti-neutrino data without any major problem.
  - Switch to neutrino mode running from October.
  - Run one more year.

Backup

Event selection for event rate study



- More than 3 hits in each view
  - Threshold: 5 sigma (~2 p.e)
- Track length > 4 layers
- Require hit in most downstream layer
- Vertex in fiducial volume
  - -130cm<x<130cm
  - -130cm<y<130cm
  - 2.62cm<z<157.2cm (2^{nd}~60^{th} layer)
- Within 2usec on-timing window (12<t<14 usec) → see page6

NOTE: This selection is just only for event rate stability check (Not for physics analysis)